

Rule 45. Rules Concerning Voting System Standards for Certification

45.1 Definitions The following definitions apply to their use in this rule only, unless otherwise stated.

- 45.1.1 "Audio ballot" means a voter interface containing the list of all candidates, ballot issues, and ballot questions upon which an eligible elector is entitled to vote ~~at in~~ an election. It and that also provides the voter with audio stimuli and allows the voter to communicate voting intent to the voting system through vocalization or physical actions.
- 45.1.2 "Audit log" means a system-generated record, in printed and/or electronic format, providing a record of activities and events relevant to initializ~~ing~~ation of election software and hardware, ~~the~~ identification of files containing election parameters, initializ~~ing~~ation of the tabulation process, processing ~~of~~ voted ballots, and terminat~~ing~~ion of the tabulation process.
- 45.1.3 "Ballot image" ~~or "Ballot image log"~~ means a corresponding representation in electronic form of the marks or vote positions of a cast ballot that are captured by a direct recording electronic voting device.
- 45.1.4 "Ballot style" ~~assignment~~ means a specific ballot layout or content the creation of unique, specific ballots for an election. The ballot style is the presentation of the unique combination of contests and candidates for which the voter is eligible to vote. It includes the order of contests and candidates, the list of ballot positions for each contest, and the binding of candidate names to ballot positions within the presentation. Multiple precincts may use a single ballot style. Multiple styles may appear in a single precinct where voters are split between two or more districts or other categories defining voter eligibility for particular contests and candidates. by the election management system based on criteria keyed into the system for districts, precincts, and races to create combinations of possibilities of races for individual voters based on their individual precincts.
- 45.1.5 "Closed network" means a network structure where in which devices are not connected to the internet or other office automation networks, except as allowable under Section 45.5.2.7.
- 45.1.6 "Communications devices" means devices that may be incorporated in, or attached to, components of the voting system for the purpose of transmitting tabulation data between components or to another data processing system, printing system, or display device.
- 45.1.7 "DRE" means a direct recording electronic voting device. A DRE is a voting device that records votes by means of a ballot display provided with mechanical or electro-optical components or an audio ballot that can be activated by the voter, ~~that~~ processes data by means of a computer program; and ~~that~~ records voting data and ballot images in memory components or other media. The device may produce a tabulation of the voting data stored in a removable memory component and as printed copy. The device may also provide a means for transmitting individual ballots or vote totals to a central location for consolidating and reporting results from remote sites to the central location.
- 45.1.8 "EAC" means the United States Election Assistance Commission.
- 45.1.9 "Election management system" includes, but is not limited to, the ballot definition subsystem and the election reporting subsystem. The election management system mMay provide utilities for other election administration tasks, including maintaining equipment inventories, estimating ballot printing needs and maintaining information on polling places.

- 45.1.1~~09~~¹⁰ "Election media" means any device including a cartridge, card, memory device, or hard drive used in a voting system for the purposes of programming ballot image data (ballot or card styles), recording voting results from electronic vote tabulating equipment, or any other data storage ~~needs~~ required by the voting system for a particular election function. The election management system typically ~~delivers (downloads)~~ ballot style information to the election media and ~~receives (uploads)~~ ~~cast ballot information in the form of a summary of~~ results and ballot images ~~from the election media~~.
- 45.1.1~~10~~¹¹ "Equipment" or "device" means a complete, inclusive term to represent all items submitted for certification by the voting system provider. This can include, but is not limited to, any voting device, accessory to voting device, DRE, touch screen voting device, card programming device, software, and hardware. ~~"Equipment" may also mean, as well as~~ a complete end to end voting system solution.
- ~~45.1.1¹¹ "FEC" means the Federal Election Commission.~~
- 45.1.1~~12~~¹² "Remote site" means any physical location identified by a ~~d~~Designated ~~e~~Election ~~o~~Official as a location where the jurisdiction shall ~~be conducting~~ the casting of ballots for a given election. A remote site includes ~~but is not limited to~~ locations such as precinct polling places, vote centers, early voting ~~sites and~~, mail-in ballot counting, ~~etc.~~
- 45.1.1~~13~~¹³ "Removable Storage Media" means ~~storage devices that can be removed from the system and transported to another location for readout and report generation. Examples of removable storage media include, but are not limited to, programmable read-only memory (PROM), random access memory (RAM) with battery backup, thumb drives, magnetic media and optical media,~~ any device that is intended to be removed that has the ability of storing or processing data for a voting system.
- ~~45.1.1¹⁴ "Secretary of State" within the context of this rule, means the Colorado Secretary of State and his or her designated agents including employees, contractors and volunteers.~~
- 45.1.1~~15~~¹⁴ "Security" means the ability of a voting system to protect election information and election system resources with respect to confidentiality, integrity, and availability.
- 45.1.1~~16~~¹⁵ "Split Precinct" means a precinct that has a geographical divide between one or more political jurisdictions which ~~may results in cause each jurisdiction within the precinct to be assigned different a unique~~ ballot styles ~~to be created~~ for a specific election.
- 45.1.1~~17~~¹⁶ "Test Log" ~~or "Test Records"~~ means ~~the~~ documentation of certification testing and processes ~~which is independently reproducible to recreate all test scenarios conducted by the testing board. This log may include documentation such as: may include, but is not limited to, certification testing reports, test plans, requirements matrices, photographs, written notes, video and/or audio recordings, ed notes.~~
- 45.1.1~~18~~¹⁷ ~~—"Trusted Build"~~ means the write-once installation disk or disks for software and firmware for which the Secretary of State or his/her agent has established the chain of evidence to the building of a disk, which is then used to establish and/or re-establish the chain of custody of any component of the voting system which contains firmware or software. The trusted build is the origin of the chain of evidence for any software and firmware component of the voting system.
- 45.1.1~~19~~¹⁸ ~~"Voting System Test Laboratory" or "VSTL" or means a "voting system testing laboratory"~~ means a "Federally Accredited Laboratory", as defined in Section 1-1-104 (16.5) C.R.S. which is accredited by ~~that provides engineering, testing, or evaluation services for voting systems, and is qualified by~~ the EAC to conduct certification

~~qualification~~ testing ~~on for a~~ voting systems.

45.2 Introduction

45.2.1 Definition of voting system for certification purposes

45.2.1.1 The definition of a voting system for the purposes of this rule shall be as the term is defined in HAVA ~~Section~~ 301(b). For Colorado purposes, no single component of a voting system, ~~or such as a precinct tabulation~~ device, meets the definition of a voting system.

45.2.1.2 Sufficient components shall be assembled to create a configuration that ~~shall~~ allow ~~s~~ the system as a whole to meet the requirements as described for a voting system in this rule.

45.2.2 Authority

45.2.2.1 Pursuant to Articles 5 and 7 of Title 1, C.R.S., the Secretary of State is expressly authorized to adopt this rule.

45.2.3 Documents Incorporated by Reference

~~45.2.3.1~~ All documents incorporated by reference in this Rule 45 do not include any later amendments or editions of the ~~see~~ documents.

~~45.2.3.2~~ All documents incorporated by reference in this Rule 45 may be viewed on the ~~"Voting Systems" page of the "Elections Center" on the~~ Secretary of State's website at ~~www.sos.state.co.us~~ <http://www.elections.colorado.gov/DDefault.aspx?tid=879> ~~www.sos.state.co.us~~, or by contacting the Secretary of State Voting ~~Equipment Certification Program Manager~~ ~~Systems Specialist~~ /1700 Broadway – Suite 270 /Denver, CO 80290.

45.3 Certification Process Overview and Timeline

45.3.1 The voting system shall be considered as a unit, and all components of such system shall be tested at once, unless the circumstances necessitate otherwise ~~(e.g., retrofitted V-VPATs, etc.)~~. Any change made to individual components of a voting system shall require ~~re-certification of the entire voting system~~ be recertified in accordance with this rule ~~unless the change is a modification that can be approved under the provisions of Section 1-5-618 (1.5) C.R.S.~~

Comment [PWC1]: This change addresses the new section 1-5-618 (1.5) CRS. In HB 09-1335

45.3.2 For a voting system to ~~pass certification~~ be certified, the voting system provider shall successfully complete all phases of the certification process, ~~which shall to include:~~ submitting a complete application; a review of the documentation to evaluate ~~if whether~~ the system meets the requirements of this rule; a public demonstration of the system; ~~and~~ functional testing of the voting system ~~which shall to~~ demonstrate substantial compliance with the requirements of this rule ~~and~~ Colorado Election Code; ~~and as well as~~ any additional testing that is deemed necessary by the Secretary of State.

45.3.3 The following ~~milestones phases~~ indicate the flow ~~and approximate times for each phase~~ of the certification process. ~~— see timeline below:~~

(a) Phase I ~~— 156 days maximum~~. Voting system provider submits an application ~~and all documentation required in Rule 45.4. The~~ ~~and~~ Secretary of State reviews the

application and informs the voting system provider whether or not the application is complete. If the application is complete, the Secretary of State makes arrangements with the voting system provider for a public demonstration. If the application is incomplete, the Secretary of State shall identify the deficiencies and the voting system provider shall have 30 days to remedy the deficiencies and make the application complete.

- (b) Phase II — ~~3016 Days maximum.~~ The Secretary of State reviews the submitted documentation, ~~conducts the review of VSTL or evaluations provided by another State under Rule 45.5.1.3,~~ submitted and prepares a certification test plan for the system and presents the test plan to the voting system provider, ~~upon successful completion, makes arrangements with voting system provider for demonstration.~~
- (c) Phase III — ~~4036 days maximum.~~ Upon receipt of the voting system provider's agreement to the test plan, ~~When demonstration is complete, the~~ Secretary of State performs the functional testing.
- (d) Phase IV — ~~302 days maximum.~~ Upon completion of functional testing, ~~the Office of the~~ Secretary of State produces a certification test report, ~~makes a decision to certify a voting system and produces applicable certification document.~~
- (e) Phase V — ~~530 days maximum.~~ The Secretary of State reviews the certification test report and makes the decision whether to certify the voting system. Upon the decision to certify a the voting system, ~~Secretary of State shall produce a qualification the certification test report report for the voting system and components certified, which shall be posted on the Secretary of State's website.~~
- (f) ~~Within thirty (30) days of deciding to certification of a voting system, the Secretary of State shall make a report on the system pursuant to Section 1-5-617(4), C.R.S. publish conditions of use and procedures for installing the trusted build.~~

45.4 Application Procedure

- 45.4.1 Any voting system provider may apply to the Secretary of State for certification at any time.
- 45.4.2 A voting system provider that submits a voting system for certification shall complete the Secretary of State's "Application for Certification of Voting System".
- 45.4.3 The voting system provider shall establish an escrow account pursuant to State procurement processes to compensate the Secretary of State for necessary outside costs associated with ~~the testing of~~ the system. The Secretary of State shall provide an estimate of costs ~~for certification testing at the conclusion of Phase II evaluation in accordance with Section 24-21-104, C.R.S.~~
- 45.4.4 Along with the application, the voting system provider shall submit all ~~the~~ documentation required in this Rule 45. The requirements include documentation necessary for the identification of the full system configuration submitted for certification. ~~This~~ Documentation shall include information that defines the voting system design, method

of operation; and related resources. It shall also include a system overview and documentation of the voting system's functionality, accessibility, hardware, software, security, test and verification specifications, operations procedures, maintenance procedures; and personnel deployment and training requirements. In addition, the documentation submitted shall include the voting system provider's configuration management plan and quality assurance program.

45.4.5 Electronic copies of documentation are preferred and shall be submitted in lieu of a hard copy when possible.

45.4.6 If the EAC has established a trusted build for the system submitted for certification, the trusted build shall be provided by the EAC. The voting system provider shall execute and submit to the EAC any necessary releases for the EAC to provide the same; and ~~shall~~ provide the Secretary of State's office with a copy of such executed releases. The voting system provider shall pay directly to the EAC any cost associated with same. In addition, the voting system provider shall submit all documentation and instructions necessary for the creation ~~of~~ and guided installation of files contained in the trusted build which will be created at the start of functional testing and will be the model tested ~~against~~. The Secretary of State reserves the right to add additional instructions or guidance for the use of the trusted build when initiating the chain of custody process for a jurisdiction using the specified equipment.

45.4.7 If the EAC does not have a trusted build for the voting system submitted for certification, the voting system provider shall coordinate with the Secretary of State for the establishment of the trusted build. At a minimum, this shall include a compilation of files placed on write-once media for which the Secretary of State has observed the chain of evidence from the time of source code ~~compliance~~compilation through delivery, and an established hash file distributed from a VSTL or the National Software Reference Library to compare federally certified versions ~~ss against~~. All or any part of the ~~t~~Trusted ~~b~~Build disks may be encrypted. If applicable, tThey should all be labeled as ~~p~~Proprietary ~~i~~Information ~~if applicable~~ and with identification of the voting system provider's name and release version based on the voting system provider's release instructions.

45.4.8 All materials submitted to the Secretary of State shall remain in the custody of the Secretary of State during the life of the certification and for twenty-five (25) months after the last election in which the system is used with the exception of any equipment provided by the voting system provider ~~to for the~~ purposes of testing.

45.4.9 In addition to the application and the documentation specified above, the Secretary of State may request additional information from the applicant, as deemed necessary, ~~by the Secretary of State.~~

45.5 Voting System Standards

45.5.1 Federal Standards

45.5.1.1 All voting systems shall meet the voting systems standards pursuant to Section 1-5-601.5, C.R.S., and Secretary of State Rule 37.3.

45.5.1.2 All voting system software, hardware; and firmware shall meet all requirements of federal law that address accessibility for the voter interface of the voting system. These laws include, but are not ~~necessarily~~ limited to, (a) the Help America Vote Act, (b) the Americans with Disabilities Act; and (c) the Federal Rehabilitation Act. The voting system provider shall explicitly acknowledge

~~explicitly~~ that their proposed software, hardware, and firmware are all in compliance with the relevant accessibility portions of these laws.

45.5.1.3 ~~The Secretary of State or his/her designee may use and rely upon the testing of a voting system performed by a VSTL or by another state upon satisfaction of the following conditions: shall review all of the documentation submitted from federal testing for compliance with applicable laws and regulations. Documentation of tests completed at the federal level may be used for compliance of duplicate State level requirements; however compliance with federal standards does not necessarily establish compliance with Colorado standards.~~

Comment [PWC2]: Implements changes in HB 09-1335

~~45.5.1.3.1 The Secretary of State has complete access to any documentation, data, reports or similar information upon which the VSTL relied in performing its tests and was created during or as a result of the testing, and will make such information available to the public subject to any redaction required by law; and~~

~~45.5.1.3.2 The Secretary of State makes written findings and certifies that he or she has reviewed the information specified in Rule 45.5.1.3.1, and determines that the tests were conducted in accordance with appropriate engineering standards in use when the tests were conducted and the extent to which the tests satisfy the requirements of Sections 1-5-615 and 1-5-616, C.R.S., and all rules promulgated under those sections.~~

45.5.2 State Standards

45.5.2.1 Functional requirements

45.5.2.1.1 Functional requirements shall address any and all detailed operations of the voting system related to the management and controls required to successfully conduct an election on the voting system.

45.5.2.1.2 The voting system shall provide for appropriately authorized users to:

- (a) Prepare the system for an election;
- (b) Setup and prepare ballots for an election;
- (c) Lock and unlock system to prevent or allow changes to ballot design;
- (d) Conduct hardware and diagnostic~~s~~ testing as required herein;
- (e) Conduct logic and accuracy testing as required herein;
- (f) Conduct an election and meet additional requirements as identified in this section for procedures for voting, auditing information, inventory control, counting ballots, opening

and closing polls, recounts, reporting, and accumulating results as required herein;

(g) Conduct the post election audit as required herein; and

(h) Preserve the system for future election use.

45.5.2.1.3 The voting system shall accurately integrate ~~election day~~Election Day voting results with mail-in, early voting and provisional ballot results.

Comment [PWC3]: See new rule 45.5.2.1.11 below.

45.5.2.1.4 The voting system shall be able to count all of an elector's votes on a provisional ballot or only federal and statewide offices and statewide ballot issues and questions, as provided under section 1-8.5-108(2), C.R.S.

45.5.2.1.5 The voting system shall provide for the tabulation of votes cast in split precincts where all voters residing in one precinct are not voting the same ballot style.

45.5.2.1.6 The voting system shall provide for the tabulation of votes cast in combined precincts at remote sites, where more than one precinct is voting at the same location, on either the same ballot style or a different ballot style.

45.5.2.1.7 The voting system application shall provide authorized users with the capability to produce electronic files including election results in either ASCII (both comma-delimited and fixed-width) or web-based format that shall contain (a) all data or (b) any user selected data elements from the database. The software shall provide authorized users with the ability to generate these files on an "on-demand" basis. After creating such files, the authorized users shall, at their discretion, have the capability to copy the files to diskette, tape, ~~or~~ CD-ROM or to transmit the files to another information system.

(a) Exports necessary for the Secretary of State shall conform to an ~~agreed-upon~~ format: agreed upon by the Secretary and the voting system provider. If the voting system provider and the Secretary have not previously agreed upon a format, the voting system provider shall provide the Secretary with specifications for all available export file formats. As part of the certification test, the voting system provider will demonstrate that preliminary and canvassing level election result data, using one or more of the provided formats, can be imported to a commercially available data management program such as a spreadsheet, database, or report generator which can accept that format and which is used and selected by the Secretary's office. Using the imported data, the Secretary's test team shall confirm that the election results data may be consolidated with results from one or more additional election jurisdictions, searched, selected, sorted, generate totals from selected subsets of the data, and formatted for reporting.

~~Exports necessary for the Secretary of State shall conform to a format agreed upon by the Secretary and the voting system provider. If the voting system provider and the Secretary have not previously agreed upon a format, the voting system provider shall provide the Secretary with specifications for all available export file formats. As part of the certification test, the voting system provider will demonstrate that preliminary and canvassing level election result data, using one or more of the provided formats, can be imported to a commercially available data management program such as a spreadsheet, database, or report generator which can accept that format and which is used and selected by the Secretary's office. Using the imported data, the Secretary's test team shall confirm that the election results data may be consolidated with results from one or more additional election jurisdictions, searched, selected, sorted, generate totals from selected subsets of the data, and formatted for reporting.~~

- (b) Export files shall be generated so that election results can be communicated to the Secretary of State on election night both during the accumulation of results and after all results have been accumulated.

45.5.2.1.8 The voting system shall include hardware and software to enable the closing of the remote voting location and disabling the acceptance of ballots on all vote tabulation devices to allow for the following:

- (a) Machine-generated paper record of the time the voting system was closed.
- (b) Readings of the public counter and protective counter shall become a part of the paper audit record upon disabling the voting system to prevent further voting.
- (c) Ability to print an abstract of the count of votes which shall contain:
 - (i) Names of the offices;
 - (ii) Names of the candidates and party when applicable;
 - (iii) A tabulation of votes from ballots of different political parties at the same voting location in a primary election;
 - (iv) Ballot titles;
 - (v) Submission clauses of all initiated, referred or other ballot issues or questions; and
 - (vi) The number of votes counted for or against each candidate or ballot issue.
- (d) Abstract shall include an election judge's certificate and statement that contains:
 - (i) Date of election (day, month and year);

- (ii) Precinct Number (ten digit format);
- (iii) County or Jurisdiction Name;
- (iv) State of Colorado;
- (v) Count of votes as indicated in this section; and
- (vi) Area for judge's signatures with the words similar to: "Certified by us", and "Election Judges". Space should allow for a minimum of two (2) signatures.

(e) Votes counted by a summary of the voting location, and by individual precincts.

(f) Ability to produce multiple copies of the unofficial results at the close of the election.

(g) Ability to accommodate a two page ballot (races on four faces) is required.

45.5.2.1.9 Voters voting on DRE ~~devices~~ shall be able to navigate through the screens without the use of page scrolling. Features such as next or previous page options shall be used.

45.5.2.1.10 The voting system application shall ensure that an election setup may not be changed once ballots are printed and/or election media devices are downloaded for votes to be conducted without proper authorization and acknowledgement by the application administrative account. The application and database audit transaction logs shall accurately reflect the name of the system operator making the change(s), the date and time of the change(s), and the "old" and "new" values of the change(s).

45.5.2.1.11 The voting system shall ensure that all tabulated results will be accurately captured, interpreted, and reported to the level of accuracy required in the 2002 Voting System Standards.

45.5.2.2 Performance Level

45.5.2.2.1 Performance Level ~~shall refer~~s to any operation related to the speed and efficiency required from the voting system to accomplish the successful conduct of an election on the voting system.

45.5.2.2.2 The voting system shall meet the following minimum requirements for casting ballots during functional testing for certification. Speed requirements are based on a printed double sided complete 18" ballot with a minimum of twenty (20) contests:

- (a) Optical Scan Ballots at voting location(s) = one hundred (100) ballots per hour;
- (b) DRE / Touch Screen = twenty (20) ballots per hour; and

- (c) Central Count Optical Scan Ballots = one hundred (100) ballots per hour.

45.5.2.2.3 The voting system provider shall publish and specify processing standards for each component of the voting system as part of the documentation required for certification.

45.5.2.2.4 For the purposes of evaluating software, the voting system provider shall be required to provide detailed information as to the type of hardware required to execute the software. The performance level shall be such that an evaluator of the software would have pauses equal to less than five (5) seconds in the system during the ballot design and creation, along with the downloading and uploading of election media devices. Specifically, the following minimum standards are required:

- (a) Ballot style initial layout is less than ten (10) seconds per ballot style;
- (b) Election ~~mMedia~~ dDownload for vote storage media without audio files is less than thirty-five (35) seconds per media;
- (c) Election ~~mMedia~~ uUpload is less than twenty (20) seconds per media; and
- (d) The application software upon creation of the layout of the races on ballot shall produce the ballot image (on screen) for the evaluator in less than thirty (30) seconds per ballot image.

45.5.2.2.5 At no time shall third party hardware or software negatively have a negative impact-effect on performance levels of the voting system application, unless, through documentation, a voting system provider specifically details ~~through documentation~~ the specific hardware or software, the performance impact, and a workaround for the end user to overcome the issue.

45.5.2.3 Physical and Design Characteristics

45.5.2.3.1 Physical and design characteristics shall address any and all external or internal construction of the physical environment of the voting system, or the internal workings of the software necessary for the ~~functioning of the~~ voting system to function. The voting system shall substantially comply with these requirements to be considered successful in the conduct of an election on the voting system.

45.5.2.3.2 The voting system shall meet the following environmental controls allowing for storage and operation in the following physical ranges:

- (a) Operating – ~~Maximum~~ 95 Degrees Fahrenheit; ~~Minimum~~ 50 Degrees Fahrenheit, with ~~maximum~~ humidity of 90%, normal or minimum operating humidity of 15%.

- (b) Non-Operating – ~~Maximum-~~ 140 Degrees Fahrenheit; ~~Minimum-~~ ~~minus~~ 4 Degrees Fahrenheit. Non-operating humidity ranges from 5% to 90% for various intervals throughout the day.

The material supplied by the voting system provider shall include a statement of all requirements and restrictions regarding environmental protection, electrical service, telecommunications service, and any other facility or resource required for the installation, operation, and storage of the voting system.

- 45.5.2.3.3 The ballot definition subsystem of the voting system application consists of hardware and software required to accomplish the functions outlined in this ~~S~~section 45.5.2.3. System databases contained in the ~~b~~Ballot ~~d~~Definition ~~s~~Subsystem may be constructed individually or they may be integrated into one database. These databases are treated as separate databases to identify the necessary types of data ~~that shall to~~ be handled and to specify, where appropriate, those attributes that can be measured or assessed for determining compliance with the requirements of this standard.

- 45.5.2.3.4 The ~~b~~Ballot ~~d~~Definition ~~s~~Subsystem shall be capable of formatting ballot styles in English and Spanish.

~~any alternate languages as are necessary to comply with The "Voting Rights Act of 1965" 42 U.S.C. § 1973c et seq. (1965).~~

- 45.5.2.3.5 The voting system application shall allow the operator to generate and maintain an administrative database containing the definitions and descriptions of political subdivisions and offices within the jurisdiction.

- 45.5.2.3.6 The ballot definition subsystem shall provide for the definition of political and administrative subdivisions where the list of candidates or contests may vary within the remote site and for the activation or exclusion of any portion of the ballot upon which the entitlement of a voter to vote may vary by reason of place of residence or other such administrative or geographical criteria. This database shall be used by the system with the administrative database to format ballots or edit formatted ballots within the jurisdiction.

- 45.5.2.3.7 For each election, the ballot definition subsystem shall allow the user to generate and maintain a candidate and contest database and provide for the production and/or definition of properly formatted ballots and software.

- 45.5.2.3.8 The ballot definition subsystem shall be capable of handling at least 500 potentially active voting positions, arranged to identify party affiliations in a primary election, offices ~~withand~~ their associated labels and instructions, candidate names ~~withand~~ their associated labels and instructions, and ballot issues or questions ~~withand~~ their associated text and instructions.

- 45.5.2.3.9 The ballot display may consist of a matrix of rows or columns assigned to political parties or non-partisan candidates and columns or rows assigned to offices and contests. The display may consist of a contiguous matrix of the entire ballot or it may be segmented to present portions of the ballot in succession.
- 45.5.2.3.10 The voting system ~~application~~ shall provide a facility for the definition of the ballot, including the definition of the number of allowable choices for each office and contest; and for special voting options such as write-in candidates. It shall provide for all voting options and specifications as provided for in Articles 5 and 7, Title 1, C.R.S. The voting system shall generate all required masters and distributed copies of the voting program in conformance with the definition of the ballot for each voting device and remote site. The distributed copies, resident or installed, in each voting device, shall include all software modules required to: monitor system status and generate machine-level audit reports,
- accommodate device control functions performed by remote location officials and maintenance personnel; and register and accumulate votes.
- 45.5.2.3.11 The trusted build of the voting system software, installation programs, and third party software ~~(such as operating systems, drivers, etc.)~~ used to install or to be installed on voting system devices shall be distributed on a write-once media.
- 45.5.2.3.12 The voting system shall allow the system administrative account to verify that the software installed is the certified software by comparing it to the trusted build or other reference information.
- 45.5.2.3.13 All DRE voting devices shall use touch screen technology or other technology providing visual ballot display and selection. The voting system provider shall provide documentation concerning the use of touch screen or other display and selection technology; including, but not limited to:
- (a) Technical documentation describing the nature and sensitivity of the tactile device (if the system uses touch screen technology);
 - (b) Technical documentation describing the nature and sensitivity of any other technology used to display and select offices, candidates, or issues;
 - (c) Any mean time between failure (MTBF) data collected on the vote recording devices; and
 - (d) Any available data on problems caused for persons who experience epileptic seizures due to the DRE voting devices' s screen refresh rate.

~~45.5.2.3.14 The voting system shall contain a control subsystem that consists of the physical devices and software that accomplish and validate the following operations:~~

~~(a) Voting System Preparation - The control subsystem shall encompass the hardware and software required to prepare remote location voting devices and memory devices for election use. Remote site preparation includes all operations necessary to install ballot displays, software, and memory devices in each voting device. The control subsystem shall be designed in such a manner as to facilitate the automated validation of ballot and software installation and to detect errors arising from their incorrect selection or improper installation.~~

~~(b) Error Detection - the voting system shall contain a detailed list and description of the error messages that will appear on the voting devices, the controller (if any), the paper ballot printer, programmer, or any other device used in the voting process to indicate that a component has failed or is malfunctioning.~~

~~45.5.2.3.15 The voting system shall have a high level of integration between the ballot layout subsystem and the vote tabulation subsystem. This integration shall permit and facilitate the automatic transfer of all ballot setup information from the automated ballot layout module to the single ballot tabulation system that will be used in a fully integrated manner for DRE, optical scan, and any other voting devices included in the voting system.~~

~~45.5.2.3.16 The processing subsystem contains all mechanical, electromechanical, and electronic devices required to perform the logical and numerical functions of interpreting the electronic image of the voted ballot and assigning votes to the proper memory registers. Attributes of the processing subsystem that affect its suitability for use in a voting system, are accuracy, speed, reliability, and maintainability.~~

~~(a) Processing accuracy refers to the ability of the subsystem to receive electronic signals produced by vote marks and timing information, to perform logical and numerical operations upon these data, and to reproduce the contents of memory when required without error. Processing subsystem accuracy shall be measured as bit error rate, which is the ratio of uncorrected data bit errors to the number of total data bits processed when the system is operated at its nominal or design rate of processing in a time interval of four (4) hours. The bit error rate shall include all errors from any source in the processing subsystem. For all types of systems, the Maximum Acceptable Value (MAV) for this error rate shall be one (1) part in five hundred thousand (500,000) ballot positions, and the Nominal Specification Value (NSV) shall be one (1) part in ten million (10,000,000) ballot positions.~~

Comment [PWC4]: Rules 45.5.2.3.14 through 45.4.2.3.18 are very similar to language in the 1990 Federal Election Commission Voting System Standards and the current Florida Voting Systems Standards. The subject matter in these rules is covered in the 2002 Voting Systems Standards. Accordingly we recommend the deletions shown.

~~(b) Memory devices that are used to retain control programs and data shall have demonstrated at least a ninety-nine and a half (99.5) percent probability of error-free data retention for a period of six months for operation and non-operation.~~

~~45.5.2.3.17 The reporting subsystem contains all mechanical, electromechanical, and electronic devices required to print reports of the tabulation. The subsystem also may include data storage media and communications devices for transportation or transmission of data to other sites. Telecommunications Devices shall not be used for the preparation or printing of an official canvass of the vote unless they conform to a data interchange and interface structure and protocol that incorporates auditing and error check as required by 45.5.2.7.~~

~~45.5.2.3.18 The approach to design shall be unrestricted, and it may incorporate any form or variant of technology that is capable of meeting the requirements of this rule, and other attributes specified herein. The frequency of voting system malfunctions and maintenance requirements shall be reduced to the lowest level consistent with cost constraints. Applicants are required to meet or exceed MIL HDBK 454; "Standard General Requirements for Electronic Equipment" that is hereby adopted and incorporated by reference, as a guide in the selection and application of materials and parts only as is relevant to this section.~~

~~45.5.2.3.149~~ All electronic voting devices ~~provided~~ supplied by the voting system provider shall have the capability to continue operations and provide continuous device availability during a period of electrical outage without any loss of election data.

(a) For optical scan devices, this capability shall include, at a minimum, for a period of not less than two (2) hours the ability to:

- ~~(i)~~ Continue to scan or image voters' ballots;
- ~~(ii)~~ Accurately t~~Tabulate~~ accurately voters' choices from the ballots;
- ~~(iii)~~ Store ~~Accurately~~ store voters' ballot choices during a period of electrical outage; and
- ~~(iv)~~ Transmit required results files accurately if power failure occurs experienced during transmittal of results.

(b) For DRE devices, this capability shall include, at a minimum, for a period of not less than two (2) hours the ability to:

- (i) Continue to present ballots accurately to voters;

- (ii) Accept voters' choices accurately on the devices;
 - (iii) Tabulate voters' choices accurately;
 - (iv) Store voters' choices accurately in all storage locations on the device; and
 - (v) Transmit required results files accurately if power failure is experienced during transmittal of results.
- (c) For V-VPAT devices connected to DREs, this capability shall include, at a minimum, for a period of not less than two (2) hours the ability to:
- (i) Continue to print voters' choices on the DRE accurately and in a manner that is identical to the manner of the printers' operations during a period of normal electrical operations; and
 - (ii) Continue to store the printed ballots in a secure manner that is identical to the manner of the printers' operations during a period of normal electrical operations.
- (d) The voting system provider shall deliver to the Secretary of State documentation detailing estimated time of ~~battery~~ operation ~~on battery~~ for each type of optical scanner, ballot imager, DRE, and V-VPAT they provide, assuming continuous use of the devices by voters during an interruption of normal electrical power.
- (e) The voting system provider shall deliver to the Secretary of State documentation specifying the steps and times required for charging batteries for each type of optical scanner, ballot imager, DRE and V-VPAT they provide.

45.5.2.3. ~~1520~~ The voting system provider's software application shall be able to recover operations after a power outage or other abnormal shutdown of the system on which that application and database are operating without loss of more than the current transaction data record on which the administrative account or authorized operator account is currently working.

45.5.2.3. ~~1624~~ The voting system shall provide capabilities to protect the ~~enforce~~ confidentiality of voters' ballot choices.

- (a) All optical scan devices, associated ballot boxes and V-VPAT storage devices shall provide physical locks and procedures to prevent disclosure of voters' confidential ballot choices during and after the vote casting operation.
- (b) All DRE devices shall provide randomization of all voter choices and stored, electronic ballot information, regardless of format, to prevent disclosure of voters'

confidential ballot choices during and after storage of the voters' ballot selections.

45.5.2.3. ~~1722~~ The voting system and all associated components shall have an estimated useful life of at least eight (8) years. ~~The v~~Voting system provider shall provide documentation ~~of for~~ the basis for ~~their~~ estimate.

45.5.2.3. ~~1823~~ The voting system provider shall submit drawings, photographs, ~~and and~~ any related brochures ~~s or~~ documents to assist with the evaluation of the physical design of the use of the voting system.

45.5.2.4 Documentation Requirements

45.5.2.4.1 ~~In addition to other documentation requirements in this rule, t~~The voting system provider shall provide the following documents:

- (a) Standard Issue Users/Operator Manual;
- (b) System Administrator's ~~/ Application Administration~~ Manual;
- (c) Training Manual ~~(and related materials)~~;
- (d) Systems Programming and Diagnostics Manuals; and
- (e) A list of minimum services needed for ~~the~~ successful, secure and hardened operation of all components of voting system.

45.5.2.4.2 ~~For the review of VSTL testing in Rule 45.5.1.3 copies of a~~All VSTL qualification reports, test logs, and technical data packages shall be ~~provided to the Secretary of State, evaluated to determine if the voting system meets the requirements of this rule and have completed the applicable federal certification requirements at the time of State testing.~~ Failure to provide such documentation of ~~independent~~ VSTL testing will result in the ~~rejection of the~~ voting system application ~~being rejected~~.

(a) The voting system provider shall execute and submit any necessary releases for the applicable VSTL and/or EAC to discuss any and all procedures and findings relevant to the voting system submitted for certification with the Secretary of State and allow the review of any documentation, data, reports or similar information upon which the VSTL relied in performing its testing by with the Secretary of State's office. The voting system provider shall provide a copy of the same to the Secretary of State's ~~office~~.

(b) The voting system provider, the VSTL and/or the EAC will shall identify to the Secretary of State any specific sections of documents for which they assert a legal requirement for redaction.

45.5.2.4.3 ~~Prior to applying for certification, a~~ All voting system providers submitting a voting system ~~for certification after March 31, 2008,~~ shall, ~~prior to applying for certification,~~ have completed ~~and provided documentation of~~ an independent analysis of the system ~~by the coordinated through the Colorado Secretary of State's office or by another state.~~ The independent analysis shall include:

(a) Application penetration test conducted to Open Source Security Testing Methodology Manual (OSSTMM) 2.2 standards for White or Double Gray box testing;

(b) Source code evaluated to the requirements identified in Section 45.5.2.6.1(f);

~~(c) A complete review of the source code for these two tests shall be provided as part of the certification process;~~

~~(cd) A complete report of acceptable~~ Recommendations on compensating controls for vulnerabilities shall be provided in the reports for with the tests conducted for items (a) and (b) of this section.

~~(i) Inability for the voting system provider to provide acceptable compensating controls will require a retest of the system under this section until all compensating controls have a valid procedural mitigation strategy.~~

~~(de) The Secretary of State~~ vender shall may use contractors with appropriate expertise and experience an EAC approved VSTL to perform the independent analysis;

~~(ef) The Secretary of State or the designated agent~~ shall review all work performed ~~by contractors~~ for quality of work product under this section. The review may include any or all of the following requirements:

(i) Review of records at contractor's or any subcontractor's site;

(ii) Interviews of the individual employees who performed the work; ~~and~~

~~(iii) Interviews of any subcontractors used.~~

~~(fg) When an analysis performed by another state is used,~~ The Secretary of State has the right to reject any evaluations performed if not satisfied with the work product and to require may request additional analysis reviews to meet the requirements of this Rule of the voting system provider.

Comment [PWC5]: The scope of some of this work is beyond that currently required for VSTLs in the EAC certification program. Accordingly although a VSTL may have the required expertise and experience, accreditation as a VSTL does not mean that they have this expertise and experience.

45.5.2.4.4 Documentation submitted to the Secretary of State shall be reviewed to determine the extent to which ensure the voting system has been tested to federal standards.

~~(a) Voting System providers shall provide the Secretary of State with their documented project plans for modifying their voting systems to comply with and achieve certification under the EAC's adopted 2005 Voluntary Voting System Guidelines by January 1, 2008 if not currently tested and certified to that standard at time of applying for certification.~~

Comment [PWC6]: This is not relevant to systems being tested to the 2002 Voting Systems Standards.

45.5.2.4.5 Failure by the voting system provider to provide any documentation with their application for certification will in the timelines established in this rule shall delay the certification process for the specific application until the documentation is provided.

45.5.2.5 Audit capacity

45.5.2.5.1 The voting system shall be capable of producing electronic and printed audit logs of system operation and system operators' actions which shall be substantially compliant to allow operations and input commands to be audited.

45.5.2.5.2 The voting systems shall include detailed documentation as to the level, location, and programming of audit trail information throughout the system. The audit information shall apply to:

- (a) Operating Systems (workstation, server, and/or DRE);
- (b) Election Programming Software;
- (c) Election Tabulation devices – optical scan and DRE; and
- (d) Election Result Consolidation and Reporting.

45.5.2.5.3 The voting system shall track and maintain audit information of the following voting system application events:

- (a) Log on and log off activity;
- (b) Application start and stop;
- (c) Printing activity, ~~-(where applicable);~~
- (d) Election events – setup, set for election, unset for election, open polls, close polls, end election, upload devices, download devices, create ballots, create precincts, create districts, create poll places (or Vote Centers), initialize devices, backup devices, and voting activity; and
- (e) Hardware events – add hardware, remove hardware, initialize hardware, and change hardware properties.

- 45.5.2.5.4 All tabulation devices shall display the unit serial number(s) both physically and within any applicable software, logs, or reports.
- 45.5.2.5.5 Vote tabulation devices shall allow for an alternate method of transfer of audit records if the device or a memory storage device is damaged or destroyed.
- 45.5.2.5.6 All transaction audit records of the voting system application database shall be maintained in a file outside of or separate from the database, which is not accessible by user/operator accounts.

45.5.2.6 Security Requirements

- 45.5.2.6.1 All voting systems submitted for certification shall meet the following minimum system security requirements:
 - (a) The voting system shall accommodate a general system of access by least privilege and role based access control. The following requirements shall apply:
 - (i) The operating system administrative account shall not have access to read or write data to the database and shall not have the ability to access or knowledge of the database administrator password;
 - (ii) The operating system administrative account shall not be required to use any function of the voting system during normal operations;
 - (iii) A unique system user/operator account shall be created for operating system use that is restricted from the following aspects of the operating system:
 - a. No access to system root directory;
 - b. No access to operating system specific folders;
 - c. No access to install or remove programs; and
 - d. No access to modify other user accounts on the system.
 - (iv) A unique application administrative account shall be created which has full access and rights to the application and database;
 - (v) A unique application user/operator account shall be created with limited rights specifically designed to perform functional operation within the scope of the application. This user/operator shall be

restricted in the creation or modification of any user/operator accounts; and

- (vi) ~~The Voting~~ voting system provider shall not have an administrative account; or administrative account access.
- (b) The voting system shall meet the following requirements for network security:
 - (i) All components of the voting system shall only be operated on a closed network only for the use of dedicated only to the voting system;
 - (ii) All components of the voting system shall include the limited use of non-routable IP address configurations for any device connected to the closed network. For the purposes of this requirement, non-routable IP addresses are those defined in the RFC 1918 Address base; and
 - (iii) The voting system shall be tested to contain provisions for updating security patches, software and/or service packs without access to the open network.
- (c) All voting systems submitted for certification ~~after March 31, 2008,~~ shall meet the following requirements for database security:
 - (i) All voting systems submitted for certification shall have databases hardened to specifications developed by the voting system provider. Documentation included with the application shall provide a detailed prescription for hardening and the procedure used to harden the system. Any government or industry guidelines adopted in whole, or in part, are to be identified in the documentation. using Oracle 9i, Oracle 10g, or Microsoft SQL shall be hardened to the existing and published NSA guidelines for databases as follows:
 - a. Oracle 9i and Oracle 10g databases shall be hardened to the Center for Internet Security Benchmark for Oracle 9i/10g Ver. 2.0;
 - b. Microsoft SQL databases shall be hardened to the NSA Guide to the Secure Configuration and Administration of Microsoft SQL Server 2000.
 - (ii) ~~All other voting system databases submitted for certification shall have the voting systems~~

Comment [PWC7]: The specific requirements for data base hardening were deleted because they are simply not workable. While they are good standards only a system built to those standards will pass. Arbitrarily applying a published standard to a system that someone has already built is probably not going to work. What is important is that the vendor provides hardening in their database where possible and that the hardening be in place. In the immediate future all of the systems tested can be expected to have some weaknesses in the security design of their databases. During certification it is important to understand those weaknesses so adequate conditions of use can be prescribed and the Secretary can make informed decisions on substantial compliance.

~~databases hardened to database manufacturer's existing hardening requirements; or~~

- (iii) ~~If the manufacturer has not established requirements for the specifically designed system, the voting systems submitted for certification shall have the voting systems databases hardened to the voting system providers' specifications.~~

(iv) ~~All voting systems submitted for certification shall have all voting systems databases restricted to allowing access to database authentication from application only (or through application only);~~

(v) ~~All data stored at rest in any voting system database shall be encrypted in accordance with section (vi) of this requirement; and~~

(vi) ~~All Cryptography modules shall be documented by the voting system provider to be certified to US Federal Information Processing Standard (FIPS-140-2), and validated to FIPS 180 standards.~~

- (d) The voting system shall meet the following requirements for operating system security:

- (i) All voting systems ~~being submitted for certification after March 31, 2008;~~ shall have all operating systems hardened to specifications developed by the voting system provider. Documentation included with the application shall provide a detailed prescription for hardening and the procedure used to harden the system. Any government or industry guidelines adopted in whole, or in part, are to be identified in the documentation. NSA guidelines for operating systems as follows:

a. ~~Apple Mac OS X systems shall be hardened to the NSA Apple Mac OS X v10.3.x "Panther" Security Configuration Guide Version 1.1;~~

b. ~~Apple Server Operating Systems shall be hardened to the NSA Apple Mac OS X Server v10.3.x "Panther" Security Configuration Guide;~~

c. ~~Microsoft Windows XP Operating systems shall be hardened to the NSA Windows XP Security Guide Version: 2.2 and the NSA Windows XP Security Guide Addendum Version 1.0;~~

d. ~~Microsoft Windows 2000 operating systems shall be hardened to the following NSA Guides:~~

- i. ~~Guide to the Secure Configuration and Administration of Microsoft Internet Information Services 5.0 Version 1.4;~~

Comment [PWC8]: The specific requirements for operating system hardening were deleted for the same reason as the database hardening above. However, this differs somewhat because operating system hardening involves issues with operational procedures of the users. It is a little more flexible than database hardening and, after evaluating the system with the hardening suggested by the vendor you may be need to require alternative hardening implementing greater or lesser levels within the conditions of use.

- ii. ~~Guide to the Secure Configuration and Administration of Microsoft ISA Server 2000 Version 1.5;~~
- iii. ~~Guide to Securing Microsoft Windows 2000 Active Directory Version 1.0;~~
- iv. ~~Guide to the Secure Configuration and Administration of Microsoft Windows 2000 Certificate Services Version 2.1.1;~~
- v. ~~Guide to Securing Microsoft Windows 2000 DHCP Version 1.3;~~
- vi. ~~Guide to Securing Microsoft DNS Version 1.0;~~
- vii. ~~Guide to Securing Microsoft Windows 2000 Encrypting File System Version 1.0;~~
- viii. ~~Guide to Securing Microsoft Windows 2000 File and Disk Resources Version 1.0.1;~~
- ix. ~~Guide to securing Microsoft Windows 2000 Group Policy Version 1.1;~~
- x. ~~Group Policy Reference Version 1.0.8;~~
- xi. ~~Guide to Securing Microsoft Windows 2000 Group Policy; Security Configuration Tool Set Version 1.2.1;~~
- xii. ~~Microsoft Windows 2000 IPSec Guide Version 1.0;~~
- xiii. ~~Guide to Windows 2000 Kerberos Settings Version 1.1;~~
- xiv. ~~Microsoft Windows 2000 Network Architecture Guide Version 1.0;~~
- xv. ~~Microsoft Windows 2000 Router Configuration Guide Version 1.02;~~
- xvi. ~~Guide to Securing Microsoft Windows 2000 Schema Version 1.0;~~
- xvii. ~~Guide to Securing Microsoft Windows 2000 Terminal Services Version 1.0; and~~
- _xviii. ~~Guide to Securing Windows NT/9x Clients in a Windows 2000 Network Version 1.0.2;~~
- e. ~~Microsoft Windows Server 2003 operating systems shall be hardened to the NSA Microsoft Windows Server 2003 Security Guide Version 2.1 and The Microsoft~~

~~Windows Server 2003 Security Guide
Addendum Version 1.0;~~

~~f. Sun Solaris 8 operating systems shall be
hardened to the NSA Guide to the Secure
Configuration of Solaris 8 Version 1.0; and~~

~~g. Sun Solaris 9 operating systems shall be
hardened to the NSA Guide to the Secure
Configuration of Solaris 9 Version 1.0.~~

(ii) The voting system provider shall submit
documentation containing a list of minimum
services and executables that are required to run
the voting system application;

~~All other voting system operating systems submitted for certification after March 31,
2008, shall have all operating systems hardened to existing manufacturer's
hardening requirements; or~~

~~(iii) If the manufacturer has not established requirements for the specifically
designed system, all voting systems being submitted for certification after March
31, 2007 shall have all operating systems hardened to the voting system
providers' specifications;~~

~~(iv) The voting system provider shall provide
documentation containing a list of minimum
services and executables that are required to run
the voting system application;~~

(iiiiv) The voting system provider shall configure the
voting system operating system of the workstation
and/or server used for the election management
software to the following requirements:

a. The ability for the system to take an action
upon inserting a removable media
(~~Autorun~~Auto run) shall be disabled; and

b. The voting system shall only boot from the
drive or device identified as the primary
drive. The voting system shall not boot from
any alternative device.

(ivi) The voting system provider shall use a virus
protection/prevention application on the election
management server(s) ~~/workstations~~ which shall
be capable of manual updates without the use of a
direct connection to the internet.

(e) The voting system shall meet the following requirements
for password security:

(i) All passwords shall be stored and used in a non-
reversible format;

- (ii) Passwords to the database shall not be stored in the database;
 - (iii) The Ppassword to the database shall be owned and ~~known~~ only known by the application;
 - (iv) The application's database management system shall require separate passwords for the administrative account and each operator account with access to the application;
 - (v) The system shall be designed in such a way to ensure~~that~~ the use of the administrative account password shall not be required for normal operating functions at any remote location;
 - (vi) The system shall be designed in such a way to facilitate the changing of passwords for each election cycle;
 - (vii) The use of blank or empty passwords shall not be permitted at any time with the exception of a limited one-time use startup password which requires a new password to be assigned before the system can be used; and
 - (viii) All voting systems submitted for certification ~~after March 31, 2008,~~ shall have all components of voting system capable of supporting passwords of a minimum of eight (8) characters, which shall be capable of including numeric, alpha and special characters in upper case or lower case used in any combination.
- (f) All voting system software submitted for certification ~~after March 31, 2008,~~ shall be in compliance with the Software Design and Coding Standards of the "Voting Systems Standards adopted in Rule 37.3. known software coding standards applicable to the base language of the application. The voting system shall meet the following minimum requirements for software security:
- (i) ~~Self-modifying, dynamically loaded or interpreted code is prohibited, except under the security provisions required by federal testing. External modification of code during execution shall be prohibited. Where the development environment (programming language and development tools) includes the following features, the software shall provide controls to prevent accidental or deliberate attempts to replace executable code:~~
 - a. ~~Unbounded arrays or strings_ (including buffers used to move data);~~

Comment [PWC9]: From here through the top of page 33 all of the deletions were requirements which are already within the 2002 standards. They are already in effect and do not need to be repeated in the rule. Establishing compliance with these standards will be subject to review during the certification process as part of the Secretary's review of VSTL testing.

language, such resources shall be placed at the lowest level where shared access is needed. If that shared access level is across multiple modules, the definitions should be defined in a single file (called header files in some languages, such as C) where any changes can be applied once and the change automatically applies to all modules upon compilation or activation.

- d. ~~Each module shall have a single entry point, and a single exit point, for normal process flow. For library modules or languages such as the object-oriented languages, the entry point is to the individual contained module or method invoked. The single exit point is the point where control is returned. At that point, the data that is expected as output shall be appropriately set. The exception for the exit point is where a problem is so severe that execution cannot be resumed. In this case, the design shall explicitly protect all recorded votes and audit log information and shall implement formal exception handlers provided by the language.~~
- e. ~~Process flow within the modules shall be restricted to combinations of the control structures defined below. This shall apply to any language feature where program control passes from one activity to the next, such as control scripts, object methods or sets of executable statements, even though the language itself is not procedural.~~
 - i. ~~In the constructs, any 'process' may be replaced by a simple statement, a subroutine or, a function call, or any of the control constructs.~~
 - ii. ~~Using the replacement rule to replace one or both of the processes in the Sequence construct with other Sequence constructs, a large block of sequential code may be formed. The entire chain is recognized as a Sequence construct and is sometimes called a BLOCK construct. Sequences shall be marked with special symbols or punctuation to delimit where it starts and where it ends.~~
 - iii. ~~A special case of the GENERAL LOOP is the FOR loop. The FOR loop may be programmed as a DO WHILE loop. The FOR loop shall execute on a counter.~~

~~The control FOR statement shall define a counter variable or variables, a test for ending the loop, and a standard method of changing the variable(s) on each pass such as incrementing or decrementing.~~

- ~~iv. The use of the FOR loop shall avoid common errors such as a loop that never ends. The GENERAL LOOP shall not be used where one of the other loop structures will serve. However, if defined in the language, it may be useful in defining some loops where the exit needs to occur in the middle. Also, in other languages the GENERAL LOOP logic may be used to simulate the other control constructs. The use of the GENERAL LOOP shall require the strict enforcement of coding conventions to avoid problems.~~
- ~~v. The voting system software code shall use uniform calling sequences. All parameters shall either be validated for type and range on entry into each unit or the unit comments shall explicitly identify the type and range for the reference of the programmer and tester. Validation may be performed implicitly by the compiler or explicitly by the programmer.~~
- ~~vi. The voting system software code shall have the return explicitly defined for callable units such as functions or procedures (do not drop through by default) for C-based languages and others to which this applies, and in the case of functions, shall have the return value explicitly assigned. Where the return is only expected to return a successful value, the C convention of returning zero shall be used. If an uncorrected error occurs so the unit shall return without correctly completing its objective, a non-zero return value shall be given even if there is no expectation of testing the return. An exception may be made where the return value of the function has a data range including zero.~~
- ~~vii. The voting system software code shall not use macro commands that contain~~

~~returns or pass control beyond the next statement.~~

~~viii. For those languages with unbound arrays, the voting system software shall provide controls to prevent writing beyond the array, string, or buffer boundaries.~~

~~ix. For those languages with pointers, or which provide for specifying absolute memory locations, the voting system software shall provide controls that prevent the pointer or address from being used to overwrite executable instructions or to access inappropriate areas where vote counts or audit records are stored.~~

~~x. For those languages supporting case statements, the voting system software shall have a default choice explicitly defined to catch values not included in the case list.~~

~~xi. The voting system software shall provide controls to prevent any vote counter from overflowing. An assumption that the counter size is large enough such that the value will never be reached does not meet this requirement.~~

~~xii. The voting system software code shall be indented consistently and clearly to indicate logical levels.~~

~~xiii. Excluding code generated by commercial code generators, the voting system software code is written in small and easily identifiable modules, with no more than 50% of all modules exceeding 60 lines in length, no more than 5% of all modules exceeding 120 lines in length, and no modules exceeding 240 lines in length. "Lines" in this context, are defined as executable statements or flow control statements with suitable formatting and comments.~~

~~xiv. Where code generators are used, the voting system software source file segments provided by the code generators shall be marked as such with comments defining the logic invoked and, a copy of the source code provided to the accredited test lab with the~~

~~generated source code replaced with an unexpanded macro call or its equivalent.~~

~~xv. The voting system software shall have no line of code exceeding 80 columns in width (including comments and tab expansions) without justification.~~

~~xvi. The voting system software shall contain no more than one executable statement and no more than one flow control statement for each line of source code.~~

~~xvii. In languages where embedded executable statements are permitted in conditional expressions, the single embedded statement may be considered a part of the conditional expression. Any additional executable statements should be split out to other lines.~~

~~xviii. The voting system software shall avoid mixed mode operations. If mixed mode usage is necessary, then all uses shall be identified and clearly explained by comments.~~

~~xix. Upon exit() at any point, the voting system software shall present a message to the operator indicating the reason for the exit().~~

~~xx. The voting system software shall use separate and consistent formats to distinguish between normal status and error or exception messages. All messages shall be self-explanatory and shall not require the operator to perform any look-up to interpret them, except for error messages that require resolution by a trained technician.~~

~~xxi. The voting system software shall reference variables by fewer than five levels of indirection.~~

~~xxii. The voting system software shall have functions with fewer than six levels of indented scope, counted as follows:~~

```
int function()  
{
```

```

_____ if (a = true)
1 _____ {
_____ if ( b = true )
2 _____ {
_____ if ( c = true )
3 _____ {
_____ if ( d =
true )
4 _____ {
_____
_____ while(while (c > 0 )
5 _____
_____ {
_____
_____ code
_____
_____ }
}
}
}
}
}

```

xxiii. ~~The voting system software shall initialize every variable upon declaration where permitted.~~

xxiv. ~~The voting system software shall have all constants other than 0 and 1 defined or enumerated, or shall have a comment which clearly explains what each constant means in the context of its use. Where "0" and "1" have multiple meanings in the code unit, even they shall be identified.~~

xxv. ~~The voting system software shall only contain the minimum implementation of~~

the "a = b ? b?c : d" syntax. Expansions such as "j=a?(b?c:d);e;" are prohibited.

xxvi. ~~The voting system software shall have all assert() statements coded such that they are absent from a production compilation. Such coding may be implemented by ifdef()s that remove them from or include them in the compilation. If implemented, the initial program identification in setup should identify that assert() is enabled and active as a test version.~~

f. ~~Control Constructs within the modules shall be limited to the acceptable constructs of Sequence, If-Then-Else, Do-While, Do-Until, Case, and the General Loop (including the special case for loop).~~

i. ~~If the programming language used does not provide these control constructs, the voting system provider shall provide comparable control structure logic. The constructs shall be used consistently throughout the code. No other constructs shall be used to control program logic and execution.~~

ii. ~~While some programming languages do not create programs as linear processes, stepping from an initial condition through changes to a conclusion, the program components may nonetheless contain procedures (such as "methods" in object-oriented languages). In these programming languages, the procedures shall execute through these control constructs or their equivalents, as defined and provided by the voting system provider.~~

iii. ~~Operator intervention or logic that evaluates received or stored data shall not redirect program control within a program routine. Program control may be redirected within a routine by calling subroutines, procedures, and functions, and by interrupt service routines and exception handlers (due to abnormal error conditions). Do-While (False) constructs and intentional exceptions (used as GoTos) are prohibited.~~

g. ~~All modules of the voting system software shall use the following naming conventions:~~

- ~~i. Object, function, procedure, and variable names shall be chosen to enhance the readability and intelligibility of the program. Names shall be selected so that their parts of speech represent their use, such as nouns to represent objects and verbs to represent functions.~~
- ~~ii. Names used in code and in documentation shall be consistent.~~
- ~~iii. Names shall be unique within an application. Names shall differ by more than a single character. All single-character names are forbidden except those for variables used as loop indexes. In large systems where subsystems tend to be developed independently, duplicate names may be used where the scope of the name is unique within the application. Names shall always be unique where modules are shared.~~
- ~~iv. Language keywords shall not be used as names of objects, functions, procedures, variables, or in any manner not consistent with the design of the language.~~
- ~~h. All modules of the voting system software shall adhere to basic coding conventions. The voting system providers shall identify the published, reviewed, and industry-accepted coding conventions used.~~
- ~~i. All modules of the voting system software shall use the following comment conventions:
 - ~~i. All modules shall contain headers. For small modules of 10 lines or less, the header may be limited to identification of unit and revision information. Other header information should be included in the small unit headers if not clear from the actual lines of code. Header comments shall provide the following information:
 - ~~1. The purpose of the unit and how it works;~~
 - ~~2. Other units called and the calling sequence;~~~~~~

~~3. A description of input parameters and output;~~

~~4. File references by name and method of access (i.e., read, write, modify or append);~~

~~5. Global variables used; and~~

~~6. Date of creation and a revision record.~~

~~ii. Descriptive comments shall be provided to identify objects and data types. All variables shall have comments at the point of declaration clearly explaining their use. Where multiple variables that share the same meaning are required, the variables may share the same comment.~~

~~iii. In-line comments shall be provided to facilitate interpretation of functional operations, tests, and branching.~~

~~iv. Assembly code shall contain descriptive and informative comments such that its executable lines can be clearly understood.~~

~~v. All comments shall be formatted in a uniform manner that makes it easy to distinguish them from executable code.~~

~~(g) i.~~ All modules of the system shall meet the following requirements for installation of software, including hardware with embedded firmware.

~~(i).~~ If software is resident in the system as firmware, the voting system provider shall ~~provide require~~ and ~~state in the system~~ documentation that ~~describes how every~~ devices ~~may is to~~ be retested to validate each ROM prior to the start of elections operations.

~~(ii).~~ ~~To prevent alteration of executable code, No~~ software shall be permanently installed or resident in the voting system unless the system documentation states that the jurisdiction shall provide a secure physical and procedural environment for the storage, handling, preparation, and transportation of the system hardware.

~~(iii).~~ The voting system bootstrap, monitor, and device-controller software may be resident permanently

as firmware, provided that this firmware has been shown to be inaccessible to activation or control by any means other than by the authorized initiation and execution of the vote counting program, and its associated exception handlers.

- (iv)- The election-specific programming may be installed and resident as firmware, provided that such firmware is installed on a component (such as a computer chip) other than the component on which the operating system resides.
- (v)- After initiation of ~~election-day~~Election Day Logic and Accuracy testing under Rrule 11.5.3, no source code, ~~or~~ compilers or assemblers shall be resident or accessible.
- (vi) .Where the system includes a feature to interpret and control execution using data from a script, code tokens, or other form of control data file separate from the source code, the human-readable source information shall be made available as part of the source code review and the data files used shall be defined and controlled as part of the Trusted Build as if it were part of the executable code.
- (vii) Security features and procedures shall be defined and implemented to prevent any changes of interpreted data files after the initial election testing of the final election definition and only allow authorized replacement of the data files with tested and approved files from the Trusted Build by authorized personnel before the election definition is finalized for an election.
- (viii) The introduction of interpreted data during execution shall not be permitted unless defined as a pre-defined set of commands or actions subject to security review and the interpretation function provides security edits on input to prevent the introduction of other commands or the modification or replacement of existing code.
- (ix+iv)- Independent analysis will test for the following conditions and report on absence or presence of the following input validations in accordance with Section 45.5.2.4.3:
 - a1. Path manipulation;
 - b2. Cross Site Scripting.Basic X;
 - c3. Resource Injection;

d4. OS Command Injection (also called "Shell Injection"); and

e5. SQL Injection.

(xvii). Independent analysis will test for the following conditions and report on their absence or presence of the following range errors in accordance with Section 45.5.2.4.3:

a1. Stack Overflow;

b2. Heap Overflow;

c3. Format string vulnerability; and

d4. Improper Null Termination.

(xiviii). Independent analysis will test for the following conditions and report on their absence or presence of the following Application Programming Interface (API) abuses in accordance with Section 45.5.2.4.3:

a1. Heap Inspection; and

b2. String Management/ Manipulation.

(ixii). Independent analysis will test for the following conditions and report on their absence or presence of the following tTime and sState conditions in accordance with Section 45.5.2.4.3:

a1. Time-of-check/Time-of-use race condition; and

b2. Unchecked Error Condition.

(xiii). Independent analysis will test for the following conditions and report on their absence or presence of the following code quality conditions in accordance with Section 45.5.2.4.3:

a1. Memory Leaks;

b2. Unrestricted Critical Resource Lock;

c3. Double Free;

d4. Use After Free;

e5. Uninitialized variable;

f6. Unintentional pointer scaling;

~~g7.~~ Improper pointer subtraction; and

~~h8.~~ Null Dereference.

~~(xiv).~~ Independent analysis will test for the following conditions and report on their absence or presence of the following encapsulation conditions in accordance with Section 45.5.2.4.3:

~~a1.~~ Private Array-Typed Field Returned from a Public Method;

~~b2.~~ Public Data Assigned to Private Array-Typed Field;

~~c3.~~ Overflow of static internal buffer; and

~~d4.~~ Leftover Debug Code.

~~(xvii).~~ The ~~a~~Application shall not open database tables for direct editing.

~~(h)k.~~ All voting systems submitted for certification ~~after March 31, 2008,~~ shall meet the following minimum requirements for removable storage media with data controls:

~~(i).~~ All voting data stored ~~that~~which includes vote records, ballot images, tally data and cast votes shall be authenticated and validated.

~~(in accordance with cryptography requirements of subsection (c)(vii) of this requirement;~~

~~(ii).~~ All non-voting data stored shall be authenticated, encrypted, and validated.

~~(in accordance with cryptography requirements of subsection (c)(vii) of this requirement; and~~

~~(iii).~~ Antivirus software shall be present and scan removable media upon insertion of media or media device on server and/or workstations hosting the elections management software.

Comment [PWC10]: The referenced rule has been deleted.

Comment [PWC11]: The referenced rule has been deleted.

45.5.2.6.2 The voting system provider shall provide documentation detailing voting system security in the areas listed below. The system shall contain documented configurations, properties and procedures to prevent, detect and log changes to system capabilities for:

(a) Defining ballot formats;

(b) Casting and recording votes;

- (c) Calculating vote totals consistent with defined ballot formats;
- (d) Reporting vote totals;
- (e) Altering of voting system audit records;
- (f) Changing, or preventing the recording of, a vote;
- (g) Introducing data for a vote not cast by a registered voter;
- (h) Changing calculated vote totals;
- (i) Preventing access to vote data, including individual votes and vote totals, to unauthorized individuals; and
- (j) Preventing access to voter identification data and data for votes cast by the voter such that an individual can determine the content of specific votes cast by the voter.

45.5.2.6.3 The voting system provider shall submit to the Secretary of State its recommended policies or guidelines governing:

- (a) Software access controls;
- (b) Hardware access controls;
- (c) Data communications;
- (d) Effective password management;
- (e) Protection abilities of a particular operating system;
- (f) General characteristics of supervisory access privileges;
- (g) Segregation of duties; and
- (h) Any additional relevant characteristics.

45.5.2.6.4 The voting system shall include detailed documentation ~~regarding~~^{to} the security measures it has in place for all systems, applicable software, devices that act as connectors (upload, download, and other programming devices), and any security measures the voting system provider recommends to the jurisdictions that purchase the voting system.

45.5.2.7 Telecommunications Requirements

45.5.2.7.1 Telecommunications includes all components of the system that transmit data outside of the closed network as defined in this Rule ~~45~~.

45.5.2.7.2 All electronic transmissions from a voting system shall meet the following minimum standards:

- (a) Modems from remote devices shall be “dial only” and cannot be programmed to receive a call;
 - (b) All communications of data in transfer shall be encrypted, authenticated and verified to the FIPS 140-2 standard and verified to the FIPS 180 standard; and
- 45.5.2.7.3 Any modem in any component failing to meet these criteria shall not be used by any voting system.
- 45.5.2.7.4 All wireless components ~~ion~~ voting systems shall be disabled with the exception of line of sight infrared technology used in a closed environment where the transmission and reception is shielded from external infrared signals and can only accept infrared signals generated from within the system.
- 45.5.2.7.5 All systems that transmit data over public telecommunications networks shall maintain a clear audit trail that can be provided to the Secretary of State when election results are transmitted by telephone, microwave or ~~any~~ other type of electronic communication.
- ~~45.5.2.7.6 Systems designed for transmission of voter information (i.e. electronic pollbooks) over public networks shall meet security standards that address the security risks attendant with the casting of ballots at remote sites controlled by election officials using the voting system configured and installed by election officials and/or their voting system provider or contractor, and using in-person authentication of individual voters.~~
- 45.5.2.7.76 Any voting system provider of systems that cast individual ballots over a public telecommunications network shall provide detailed descriptions of:
 - (a) All activities mandatory to ensur~~ing~~ effective system security to be performed in setting up the system for operation, including testing ~~of~~ security before an election.
 - (b) All activities that should be prohibited during system setup and during the time frame for voting operations, ~~including both the hours when polls are open and when polls are closed.~~
- 45.5.2.7.87 In any situation in which the voting system provider’s system transmits data through any telecommunications medium, the system shall be able to recover, either automatically or with manual intervention, from incomplete or failed transmission sessions and resume transmissions automatically when telecommunications are re-established.
 - (a) Recovery of transmissions shall include notations of the interrupted transmission session and the resumed transmission session in the system and application transaction logs.

Comment [PWC12]: This was deleted because, our understanding is that Colorado does not consider e-Pollbooks as voting systems.

- (b) Failure and recovery of transmissions shall not cause any error in data transmitted from the polling place to the central election site during a recovered transmission session.

45.5.2.7.98 ~~Any~~ Voting systems ~~provider of systems~~ that use public telecommunications networks shall provide system documentation that clearly identifies all COTS hardware and software products and communications services used in the development and/or operation of the voting system, including operating systems, communications routers, modem drivers and dial-up networking software. Documentation shall identify the name, voting system provider, and version used for each such component.

45.5.2.7.109 Voting systems providers shall document how they plan to monitor and respond to known threats to which their voting systems are vulnerable. This documentation shall provide a detailed description, including scheduling information, of the procedures the voting system provider will use to:

- (a) Monitor threats, such as through the review of assessments, advisories, and alerts for COTS components;
- (b) Evaluate the threats and, if any, proposed responses.
- (c) Develop responsive updates to the system and/or corrective procedures; and
- (d) As part of the certification requirements of the proposed system, provide assistance to customers, either directly or through detailed written procedures, how to update their systems and/or to implement the corrective procedures within the timeframe established by the Secretary of State.

45.5.2.8 Accessibility Requirements

45.5.2.8.1 Specific minimum accessibility requirements include those specified in section 1-5-704 C.R.S., Secretary of State Rule 34, Rule 35 and the following:

~~(a) Buttons and controls shall be distinguishable by both shape and color;~~

(ab) Audio ballots shall meet the following standards:

- (i) The voting system shall allow the voter to pause and resume the audio presentation;
- (ii) The audio system shall allow voters to control within reasonable limits, the rate of speech;

(be) No voting system or any of its accessible components shall require voter speech for its operation;

Comment [PWC13]: Section 1-5-704(1)(c) CRS and rule 35.1.4 require the controls be "tactilely discernable." The rule also provides that only those controls used to operate the system without vision meet the requirement. The requirement for both shape and color differences restricts design. The standard 12 key telephone button array pad is considered to be "tactilely discernable" and its use would be fatal to certification under the prior language.

Comment [PWC14]: This conflicts with section 1-5-704 CRS and rule 35.1.1 which provide that the voting system shall include a tactile or audio/speech input device. It is agreed that the voting system as a whole should not require voter speech, the statute and rule on accessibility appear to allow speech or sounds as voter input to an accessible device.

~~(ed)~~ All touchscreen technology shall be tested for use of fingers as well as non-human touch that is both wet and dry;

~~(dce)~~ Voting systems shall include at least the ability to activate and navigate by means of push buttons, dials, wheels, keypads, and/or touch screens. All voting systems submitted for certification after March 31, 2008, shall also include any form of either switches, sip and puff devices, or additional blink control devices; and

~~(edf)~~ The ability to Adjustability of the color settings, screen contrasts and/or screen angles/tilt may be made by either the poll worker or voter if the system uses a display screen. A minimum of two (2) color settings, two (2) contrast settings and two (2) angles shall be available for all display screens.

45.5.2.8.2 Documentation of the accessibility of the voting system shall include the following items at a minimum:

- (a) If appropriate, voting booth design features that provide for privacy for the voter while voting ~~(if a voting booth is not included with the system, then describe how voter privacy is accomplished)~~;
- (b) Adaptability of the proposed system for voters with disabilities as outlined in the Americans with Disabilities Act guidelines;
- (c) Technology used by the voting system that prevents headset/headphone interference with hearing aids;
- (d) Types and size of voice file(s) the voting system uses;
- (e) Method for recording, sharing and storing voice files in the voting system;
- (f) How ~~paginating navigation~~ through viewable screens is accomplished if it is required with the voting system;
- (g) Various methods of voting to ensure access by persons with multiple disabilities;
- (h) Capabilities of the voting system to accurately accept a non-human touch as input on the touch screen; and
- (i) Method for adjusting color settings, screen contrasts, and screen angles/tilt if the system uses a display screen.

45.5.2.9 Voter-Verifiable Paper Record Requirements (V-VPAT)

45.5.2.9.1 V-VPAT shall refer to a Voter-verified paper record as defined in ~~S~~section 1-1-104(50.6)(a), C.R.S.

- 45.5.2.9.2 Existing systems that are retrofitted to comply with this ~~law-rule~~ shall be examined for certification by the Secretary of State. Any retrofitted voting system shall comply with the process and application for certification as identified by this ~~R~~rule 45.
- 45.5.2.9.3 The V-VPAT shall consist of the following minimum components:
- (a) The voting device shall contain a paper audit trail writer or printer that shall be attached, built into, or used in conjunction with the DRE. The printer shall duplicate a voter's selections from the DRE onto a paper record;
 - (b) The unit or device shall have a paper record display unit or area that shall allow a voter to view his or her paper record;
 - (c) The V-VPAT unit shall contain a paper record storage unit that shall store cast and spoiled paper record copies securely; and
 - (d) These devices may be integrated as appropriate to their operation.
- 45.5.2.9.4 V-VPAT devices shall allow voters to verify his or her selections on a paper record prior to casting ballots. The voter shall either accept or reject the choices represented on the paper record. Both the electronic record and the paper record shall be stored and retained ~~upon the completion of casting a ballot~~when the ballot is cast.
- 45.5.2.9.5 The V-VPAT printer connection may be any standard, publicly documented printer port (or the equivalent) using a standard communication protocol.
- 45.5.2.9.6 The printer shall not be permitted to communicate with any ~~other~~ device other than the voting device to which it is connected.
- 45.5.2.9.7 The printer shall only be able to function as a printer, and not perform any other non-printer related services.
- 45.5.2.9.8 Every electronic voting record shall have a corresponding paper record.
- 45.5.2.9.9 The paper record shall be considered an official record of the election available for recounts, and shall be sturdy, clean, and of sufficient durability to be used for this purpose.
- 45.5.2.9.10 The V-VPAT device shall be designed to allow every voter to review, and accept or reject his/her paper record in as private and independent manner as possible for both disabled and non-disabled voters.
- 45.5.2.9.11 The V-VPAT system shall be designed ~~in conjunction with sState~~ Law to ensure the secrecy of votes so that it is not possible to determine which voter cast which paper record.

- 45.5.2.9.12 The V-VPAT printer shall print at a font size no less than ten (10) points for ease of readability. Any protective covering intended to be transparent shall be in such condition that it can be made transparent by ordinary cleaning of its exposed surface.
- 45.5.2.9.13 The V-VPAT system shall be designed to allow each voter to verify his or her vote on a paper record in the same language they voted in on the DRE.
- 45.5.2.9.14 The V-VPAT system shall be designed to prevent tampering with unique keys and/or seals for the compartment that stores the paper record, as well as meet the security requirements of this rule. Additional security measures may be in place on the printer to prevent tampering with the device.
- 45.5.2.9.15 The V-VPAT system shall be capable of printing and storing paper record copies for at least seventy-five (75) ballots cast without requiring the paper supply source, ink or toner supply, or any other similar consumable supply to be changed, assuming a fully printed double sided eighteen (18) inch ballot with a minimum of twenty (20) contests.
- 45.5.2.9.16 The V-VPAT unit shall provide a "low supply" warning to the election judge to add paper, ink, toner, ribbon or other like supplies. In the event that an election judge is required to change supplies during the process of voting, the voter shall be allowed to reprint and review the paper audit trail without having to re-mark his or her ballot, and the device shall prevent the election judge from seeing any voters' ballots.
- 45.5.2.9.17 All voting systems submitted for certification ~~after March 31, 2008~~, shall stop the V-VPAT printer of all forward operations of the DRE if the printer is not working due to paper jams, out of ~~other supply of~~ consumables, or any other issue which may cause the correct readable printing of information on the V-VPAT record as designed.
- 45.5.2.9.18 The voting system provider shall provide procedures and documentation for the use of the V-VPAT device.
- 45.5.2.9.19 The printed information on the printed ballot or verification portion of the V-VPAT device shall contain at least the following items:
- (a) Name or header information of race, question or issue;
 - (b) Voter's selections for the race information;
 - (c) Write-in candidate's names if selected;
 - (d) Undervote or overvote information – this is in addition to the information on the review screen of the DRE;
 - (e) Ability to optionally produce a unique serial number (randomized to protect privacy); and

(f) Identification that the ballot was cancelled or cast.

45.5.2.9.20 The V-VPAT shall allow a voter to spoil his or her paper record no more than two (2) times. Upon spoiling, the voter shall be able to modify and verify selections on the DRE without having to reselect all of his or her choices.

45.5.2.9.21 Before the voter causes a third and final record to be printed, the voter shall be presented with a warning notice that the selections made on screen shall be final and the voter shall see and verify a printout of his or her vote, but shall not be given additional opportunities to change their vote.

45.5.2.9.22 ~~When All~~ V-VPAT components ~~are shall be capable of~~ integrated into voting systems the new configuration of the system must comply with existing state testing and auditing requirements.

~~of the voting system.~~

45.5.2.9.23 The V-VPAT component should print a barcode with each record that contains the human readable contents of the paper record and digital signature information. The voting system provider shall include documentation of the barcode type, protocol, and/or description of barcode and the method of reading the barcode as applicable to the voting system.

45.5.2.9.24 The V-VPAT component shall be designed such that a voter shall not be able to leave the voting area with the paper record.

45.5.2.9.25 If used for provisional ballots, the V-VPAT system shall be able to mark paper records as a provisional ballot through the use of human readable text and optionally printing barcode and/or serial number information which shall provide for mapping the record back to both the electronic record and the provisional voter for processing after verification in accordance with Article 8.5 of Title 1 C.R.S.

45.5.2.9.26 The voting system provider shall provide procedures to the Secretary of State with the application for certification which describe shall keep on file procedures submitted by the voting system provider for how to investigate and resolve malfunctions including, but not limited to: misreporting votes, unreadable paper records, paper jams, low-ink, misfeeds, preventing the V-VPAT from being a single point of failure, recovering votes in the case of malfunction and power failures.

45.6 Testing

45.6.1 Voting System Provider Demonstration

45.6.1.1 The voting system provider shall demonstrate the exact proposed voting system to the Secretary of State ~~or his or her designee~~ prior to any functional testing. ~~It should be expected that a minimum of 6 hours would be required of~~

~~the voting system provider to demonstrate and assist with programming of the software as necessary.~~

45.6.1.2 The demonstration period does not have a pre-determined agenda for the voting system provider to follow; however, presentations should be prepared to address and demonstrate, with the specific system, the following items as they pertain to each area and use within the voting system:

- (a) System overview;
- (b) Verification of complete system matching EAC certification;
- (c) Ballot definition creation;
- (d) Printing ballots on demand;
- (e) Hardware diagnostics testing;
- (f) Programming election media devices for various count methods:
 - (i) Mail-in Ballots;
 - (ii) Early Voting;
 - (iii) Precinct/Poll Place;
 - (iv) Provisional; and
 - (v) Vote Center.
- (g) Sealing and securing system devices;
- (h) Logic and accuracy testing;
- (i) Processing ballots;
- (j) Accessible use;
- (k) Accumulating results;
- (l) Post-election audit;
- (m) Canvass process handling;
- (n) Audit steps and procedures throughout all processes;
- (o) Certification of results; and
- (p) Troubleshooting.

45.6.1.3 The voting system provider shall have access to the demonstration room for one ~~(1) day~~ hour prior to the start of the demonstration to provide time for setup of the voting system.

- 45.6.1.4 A maximum of one3 (1) business days ~~is normally—24 hours total shall be~~ allowed for the demonstration. ~~—If the voting system provider requests more time for the demonstration or, if the Secretary of State finds that the complexity of the system is such that more time is needed for a demonstration, more time may be granted.~~
- 45.6.1.5 The demonstration shall be open to representatives of the press and the public to the extent allowable. The Secretary of State may limit the number of representatives from each group to accommodate space limitations and other considerations.
- 45.6.1.6 The Secretary of State shall post notice of the fact that the demonstration will take place in the designated ~~public place~~legal instrument— public place for posting such notices for at least seven (7) days ~~before—prior to~~ the demonstration. The notice shall indicate the general time frame during which the demonstration may take place and the manner in which members of the public may obtain specific information about the time and place of the test.
- 45.6.1.7 The voting system provider shall provide the same class of workstation and/or server for testing the voting system as the normal production environment for the State of Colorado.

45.6.2 Functional Testing

45.6.2.1 Voting system provider requirements for testing

- 45.6.2.1.1 Based upon the review of VSTL or other state reports and test records, the Secretary of State will prepare a test plan. The test plan shall be designed to test for any requirements specific to Colorado law which were not addressed in prior testing and for any federal or Colorado requirements which were not addressed to the satisfaction of the Secretary of State in the reports and records from prior testing.
- 45.6.2.1.2 The test plan shall include the election definitions to be used in testing and specifications for test ballots. Test ballots and election definitions shall generally follow all requirements for election definitions, ballot layout and printing to verify the system's ability to meet those requirements. Some election definitions and ballots may depart from the requirements in order to test specific functions.
- 45.6.2.1.3 For each system tested, a requirements matrix shall be prepared to identify those requirements satisfied by the review of VSTL or other state reports and test data and how those requirements not satisfied are to be tested or otherwise satisfied. If during test planning or testing one of the requirements in the voting systems standards or in this rule are determined to be not applicable to the system under test, the reason for the determination will be documented.
- 45.6.2.1.4~~4~~ The voting system provider shall submit for testing the specific system configuration that ~~shall—will~~ be offered to jurisdictions including the components with which the voting system provider recommends ~~that~~ the system be used.

Comment [PWC15]: These changes are suggestions for making the testing process more efficient.

45.6.2.1.52 The voting system provider is ~~not~~ required to have a representative be present for during the functional testing to witness the testing and to, but shall provide the test team with a point of contact for technical support. After the delivery, unpacking and initial inspection of the equipment for shipping damage and missing components, the representative shall be prohibited from operating or touching the equipment until testing is complete. The representative will be available to quickly and accurately respond to questions from the test team in order to minimize delays and errors in testing.

45.6.2.1.63 The ~~proprietary-voting system~~ software shall be installed on the workstation/server and all applicable voting system components by the ~~testing board~~ Secretary of State using the following the verification of the trusted build, and using the installation procedures provided by the voting system provider. After installation, hash values for the software and firmware shall be compared to any published hash values of the trusted build. Any mismatches in hash values will be investigated and resolved before proceeding with testing. ~~verified to the trusted build hash values.~~

45.6.2.1.7 All equipment shall be hardened using the voting system provider's procedures and specifications.

45.6.2.1.84 ~~Testing~~ The test shall be performed with tests election definitions and test ballots and as required in the test plan, an election setup file, as determined by the Secretary of State.

45.6.2.1.9 The results of all testing shall be recorded in the requirements matrix. The requirements matrix shall be the primary record describing which requirements were met and specifying which were not. It shall be supplemented as necessary to support the findings with test team notes and system reports. Supplemental information may include photographs and audio or video recordings.

45.6.2.1.105 Functional testing shall be completed according to the ~~phases~~ schedule identified in ~~S~~ section 45.3.3.

45.6.2.2 Secretary of State requirements for testing

45.6.2.2.1 The Secretary of State ~~or the designee~~ shall conduct functional testing on the voting system based on this ~~R~~ rule 45 and additional testing procedures as determined by the Secretary of State.

45.6.2.2.2 The voting system shall receive a pass, fail or not applicable for each ~~requirement test conducted~~ with appropriate ~~notation~~ on the requirements matrix test log.

45.6.2.2.3 ~~Records~~ A test log of the testing procedures shall be maintained and ~~recorded-kept~~ on file with the Secretary of State. The records This test log shall identify the system and all components by voting system provider name, make, model, serial number,

software version, firmware version, date tested, test number, test plan, requirements matrix test description, testing team notes and other supplemental information of test, applicable test scripts, and results of test. The~~All~~ test environment conditions shall be ~~described~~noted.

~~45.6.2.2.4 All operating steps, the identity and quantity of simulated ballots, annotations of output reports, any applicable error messages and observations of performance shall be recorded.~~

~~45.6.2.2.45 In the event that a deviation from the test plan is required, it shall be documented in a test team note. The note shall provide a description of the deviation, the reason for the deviation and effect of the deviation on testing and determining compliance with requirements. to requirements pertaining to the test environment, voting system arrangement and method of operation, the specified test procedure, or the provision of test instrumentation and facilities is required, this deviation shall be recorded in the test log together with a discussion of the reason for the deviation and a statement of the effect of the deviation on the validity of the test procedure.~~

45.6.2.3 General Testing Procedures and Instructions

45.6.2.3.1 Certification tests shall be used to determine compliance with applicable performance standards for the system and its components. The general procedure for these tests shall:

- (a) Verify, by means of the applicant's standard operating procedure, that the device is in a normal condition and status;
- (b) Establish the standard test environment or the special environment required to perform the test;
- (c) Invoke all operating modes or conditions necessary to initiate or to establish the performance characteristic to be tested;
- (d) Measure and record the value or the range of values of the performance characteristic to be tested; and
- (e) Verify all required measurements have been obtained, and that the device is still in a normal condition and status.

~~45.6.2.3.2 All Tests shall be generally conducted as described in this section 45.6.2.3 in regular election mode. Tests of test mode and diagnostic functions may be conducted in the appropriate test mode. At no point shall testing be conducted in any form of test mode.~~

~~45.6.2.3.3 Each voting system shall be tested and examined by conducting at least three mock elections which shall include voting scenarios~~

~~that exist within a primary, a coordinated election, and a recall election.~~

~~45.6.2.3.4 Each component of the voting system shall contain provisions for verifying it is functioning correctly and, whether operation of the component is dependent upon instructions specific to that election. Test scripts shall be substantive and qualitative in form with expected results listed for each test.~~

~~45.6.2.3.5 Election scenarios shall feature at least 10 districts (or district types), comprised of at least 20 precincts that will result in a minimum of 5 unique ballot styles or combinations as indicated in the instructions to providers.~~

45.6.2.3.6 The voting system provider is required to produce ballots and assemble marked test decks and spare ballots as specified in the test plan, in quantities identified below for each of the elections. ~~Enough ballots need to be created to conduct the testing of the voting system as defined in this rule. One complete set of ballots will be tested in each of the applicable counter types (or groups) indicated below:~~

~~(a) Poll Place or Vote Center — ballots are flat — no score marks;~~

~~(b) Early Voting — ballots are flat — no score marks;~~

~~(c) Mail-in — ballots are scored and folded to fit in standard Colorado Mail-in Ballot Envelopes; and~~

~~(d) Provisional — ballots are flat — no score marks.~~

45.6.2.3.7 All ballots provided shall be blank with no marks on them. The following combinations of ballots are required:

~~(a) Four separate decks of ballots shall be provided consisting of 25 ballots for each precinct/precinct split generated for each election that are flat (1500 minimum combined). At least one deck shall have the General Election data, and at least one shall have the Primary election data as indicated in the instructions for voting system providers;~~

~~(b) Four separate decks of ballots shall be provided consisting of 25 ballots for each precinct/precinct split generated for each election that are folded (1500 minimum combined). At least one deck shall have the General Election data, and at least one shall have the Primary election data as indicated in the instructions for voting system providers;~~

~~(c) Four separate decks of ballots consisting of 300 ballots of any single precinct from each election. Two of these decks shall be printed in all alternative languages as required for the State of Colorado pursuant to section 45.5.2.3.5;~~

~~(d) One separate deck of ballots consisting of 200 ballots of any single precinct from the Coordinated election shall be provided that contains a two page ballot (races on four faces);~~

~~(e) One separate deck of ballots consisting of 10 ballots for each precinct generated for the Recall election that are flat as indicated in the instructions for voting system providers; and~~

~~(f) Any voting system provider that uses serial numbers printed on ballots for processing shall produce ballots of each requirement above printed both with and without serial numbers.~~

45.6.2.3.8 The voting system provider shall provide a minimum of ten (10) ballot marking pens/pencils/markers as defined by their system for marking ballots by the Secretary of State ~~or the designee.~~

45.6.2.3.9 For mark-sense or optical scan devices, the Secretary of State will prepare one (1) or more test ballots with ~~The testing board shall mark a minimum of 300 ballots with~~ marking devices of various color, weight, and consistency to determine the range of marks that can be read and the range and consistency of reading marginal marks. ~~accurate counting with a variety of marking devices.~~

45.6.2.3.10 Ballots shall be cast and counted in all applicable counter types (or counter groups) as necessary based on the parts included in the voting system. These are, at a minimum, ~~:-~~ Poll Place (or Vote Center), Mail-in, Provisional, and Early Voting.

~~Ballots may be run through components 10 or more times depending on components and counter group being tested to achieve a minimum number of ballots cast as follows for each group:~~

~~(a) Polling Place / OS = 1,500;~~

~~(b) Polling Place / DRE = 500;~~

~~(c) Vote Center/ OS = 5,000;~~

~~(d) Vote Center / DRE = 500~~

~~(e) Early Voting / OS = 5,000;~~

~~(f) Early Voting / DRE = 250;~~

~~(g) Mail-in = 10,000; and~~

~~(h) Provisional = 5,000.~~

45.6.2.3.11 Ballot design shall be sufficient to verify the cover the scope of allowable ballot designs for the given system under Colorado election law. ~~For example, if a system is capable of producing~~

~~11" and 18" ballots, then both ballot styles shall be tested in each of the elections above. If more sizes are available, they shall also be tested. Ballots shall be designed and presented with a maximum of four (4) columns and a minimum of one (1) column.~~

45.6.2.3.12 Ballots shall be printed in applicable languages as required by ~~s~~State and/or federal law.

45.6.2.3.13 Ballots shall include candidates to represent the maximum number of political parties in the State of Colorado, and shall accommodate all qualified political parties and political organizations.

45.6.2.3.14 ~~The requirements matrix shall include the following requirements for election definitions and ballots. Ballots shall include the following minimum race situations to simulate and test "real world" situations in the State of Colorado. Election definitions and ballots shall include the following minimum race contest situations; criteria.~~

- (a) Parties for different races;
- (b) Selection of a pair of candidates ~~_(i.e. president and vice president);~~
- (c) In a Primary Election, allow ~~a~~ voters to vote for the candidates of the party ~~for which they are eligible of his or her choice~~ and for any and all non-partisan candidates and measures, while preventing them ~~m-voter~~ from voting ~~on candidates for a candidate~~ of another party;
- (d) In a general election, allow a voter to vote for any candidate for any office, in the number of positions allowed for the office, and to ~~vote for~~select any measure on the ballot that the voter is allowed to vote in, regardless of party;
- (e) Allow for programming to accommodate Colorado recall questions as prescribed in Article 12 of Title 1, C.R.S.;
- (f) A minimum of ~~twenty (20)~~ pairs of "yes" and "no" positions for voting on ballot issues; and
- (g) Ability to contain a ballot question or issue of at least ~~two hundred (200)~~ words.

45.6.2.3.15 Additional tests and procedures may be requested at the discretion of the Secretary of State. ~~These tests and procedures will be documented in the test plan and added to the requirements matrix.~~

45.6.3 Certification

45.6.3.1 The Secretary of State shall certify voting systems that substantially comply with the requirements in this ~~Rule 45~~, Colorado Election Code, and any additional testing that is deemed necessary by the Secretary of State.

45.6.3.2 If any malfunction or data error is detected, its occurrence and the duration of operating time preceding it shall be recorded for inclusion in the analysis and the test shall be interrupted. If corrective action is taken to restore the devices to a fully operational condition within ~~eight~~ (8) hours, then the test may be resumed at the point of suspension.

45.7 Temporary Use

45.7.1 If a voting system provider has a system that has been ~~tested~~approved by an VSTL, but has not yet been approved for certification through the Secretary of State, the voting system provider or the designated election official may apply to the Secretary of State for temporary approval of the system to be used for up to (1) one year.

45.7.2 Upon approval of temporary use, a jurisdiction may use the voting system, or enter into a contract to rent or lease the voting system for a specific election upon receiving written notice from the Secretary of State's office. At no time shall a jurisdiction enter into a contract to purchase a voting system that ~~has~~ been approved for temporary use.

45.7.3 The Secretary of State shall approve use of a temporarily approved voting system for each election that a jurisdiction ~~would like~~requests permission to conduct with the voting system.

45.7.4 Temporary use does not supersede the certification requirements and/or process, and may be revoked at any time at the discretion of the Secretary of State.

45.8 Periodic Review

45.8.1 The Secretary of State shall periodically review the voting systems in use in Colorado to determine if the system(s):

- (a) Are defective, obsolete, or unacceptable for use based on the requirements of this ~~Rule 45~~; and
- (b) Have been modified from certified and trusted build versions of hardware or software;

45.8.2 The Secretary of State shall review a minimum of two (2) randomly selected jurisdictions and voting systems per calendar year at the choosing of the Secretary of State.

45.8.3 The Secretary of State shall conduct an annual visual inspection of all software incident records maintained by each voting system provider certified for use in the State of Colorado.

45.8.4 After such review, certification or temporary approval for use may be withdrawn. Three (3) months notice shall be given prior to withdrawing certification of any voting system unless the Secretary of State shows good cause for a shorter notice period.

45.8.5 All forms, notes and documentation from a periodic review shall be kept on file with the Secretary of State.

45.9 Decertification

45.9.1 If, after any time the Secretary of State has certified a voting system, it is determined that the voting system fails to substantially meet the standards set forth in this ~~R~~rule 45, the Secretary of State shall notify any jurisdictions in the State of Colorado and the voting system provider of that particular voting system that the certification of that system for future use and sale in Colorado is to be withdrawn.

45.9.2 Certification of a voting system may be revoked and/or suspended at the discretion of the Secretary of State based on information that may be provided after the completion of the initial certification. This information may come from any of the following sources:

- (a) The Election Assistance Commission (EAC);
- (b) Voting Systems Testing Laboratories (VSTL);
- (c) The Federal Election Commission (FEC);
- (d) The National Software Reference Library (NSRL);
- (e) National Association of State Election Directors (NASD);
- (f) The National Association of Secretaries of State (NASS);
- (g) Information from any state elections department or Secretary of State; and/or
- (h) Information from Colorado County Clerk and Records or their association.

~~45.9.3 Any use of a decertified or uncertified voting system for any jurisdiction in the State of Colorado shall result in possible loss of future and other existing certifications within the State, at the discretion of the Secretary of State.~~

45.9.4 Pursuant to section 1-5-621, C.R.S., the Secretary of State shall hold a public hearing to consider the decision to decertify a voting system.

45.10 Modifications and Re-examination

45.10.1 Any ~~field~~ modification, change, or other alteration to a certified voting system shall require certification or review under Section 1-5-618 C.R.S. unless the voting system provider decides to present the modified system for certification under this Rule 45 approval or certification before it may be used in any election within the State of Colorado.

~~45.10.2 A voting system provider may apply to the Secretary of State for the review of a modification of an existing certified system at any time during the year. Secretary of State shall conduct sufficient testing to ensure that all incremental changes to any voting system being submitted for certification meet all security requirements set forth in this rule.~~

45.11 Acceptance Testing by Jurisdictions

45.11.1 Whenever an election jurisdiction acquires a new system or modification of an existing system certified by the Secretary of State, the election jurisdiction shall perform acceptance tests of the system before it may be used to cast or count votes at any election. The voting system shall be operating correctly, pass all tests as directed by the acquiring jurisdiction's project manager or contract negotiator, and shall be identical to

the voting system certified by the Secretary of State.

45.11.2 The voting system provider shall provide all manuals and training necessary for the proper operation of the system to the jurisdiction, or as indicated by their contract.

45.11.3 The election jurisdiction shall perform a series of functional and programming tests that ~~shall~~ test all functions of the voting system at their discretion.

45.11.4 The jurisdiction shall coordinate acceptance testing with the Secretary of State's ~~designated agent and complete a Jurisdiction Acceptance Test form provided by the Secretary of State.~~

45.12 Purchases and Contracts

45.12.1 Any voting system that has been certified under the procedures of this Rule 45 are eligible for purchase, lease, or rent for use by jurisdictions within the State of Colorado providing the contract contains the following items:

- (a) The voting system is certified for use within the sState;
- (b) Contract contains training and maintenance costs for jjurisdiction; and
- (c) Contract identifies components contained in the certified voting system, and appears complete with all accessories necessary for successfully conducting an election within the laws and rules of the State of Colorado.

45.12.2 The Secretary of OState shall maintain on file a list of all components used and purchased for use. The list shall include, at a minimum, the name of the jurisdiction, the date of purchase, the serial number(s) of voting devices and name of the voting systems that was purchased.